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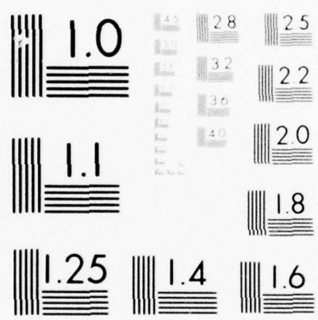

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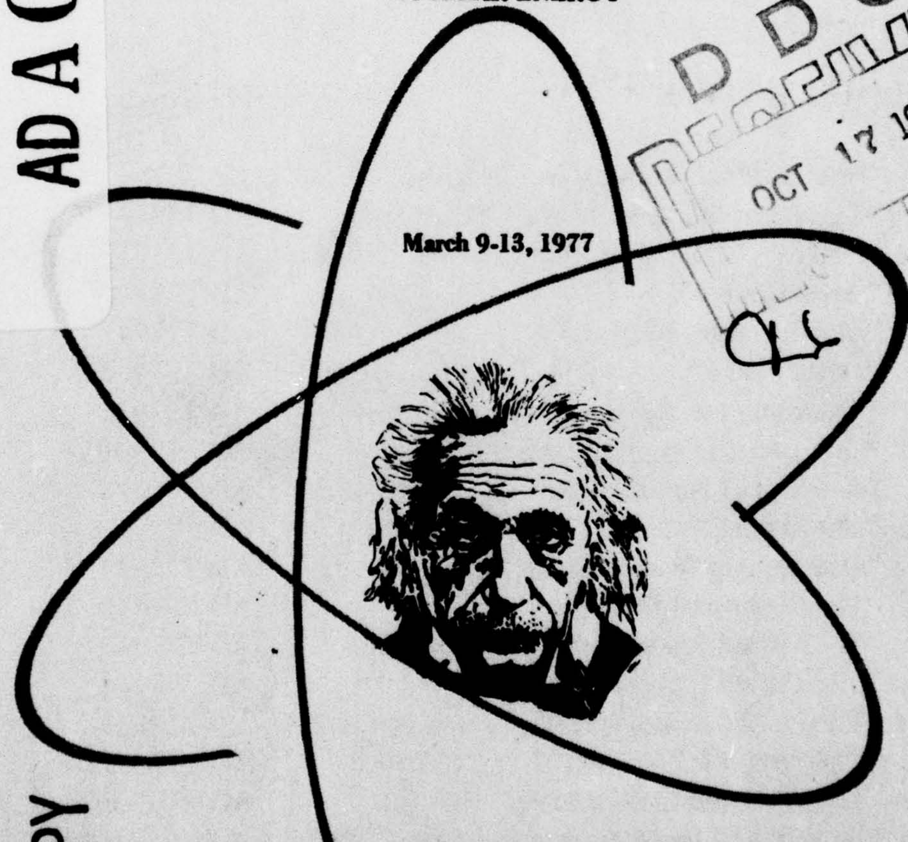
The Nineteenth Air Force Academy Assembly

NUCLEAR ENERGY

March 9-13, 1977



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PROCEEDINGS

OF

The ~~Nineteenth~~ Air Force Academy Assembly (19th)

on/ **NUCLEAR ENERGY: DO THE BENEFITS OUTWEIGH THE RISKS**, held at the Air Force Academy, Colorado on

March 9-13, 1977,

(10) Charles L. /Fox

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The Nineteenth Air Force Academy Assembly is cosponsored by the American Assembly, Columbia University, New York and the United States Air Force Academy.

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THE NINETEENTH AIR FORCE ACADEMY ASSEMBLY

United States Air Force Academy

LIEUTENANT GENERAL JAMES R. ALLEN
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Dean of the Faculty

The American Assembly

MR. CLIFFORD C. NELSON
President

OBJECTIVES

To provide an outstanding group of college students with an opportunity to study and discuss major national and international issues.

To provide these students with a realization of the difficulties of analyzing and reaching consensus on such issues.

To develop in them an appreciation for a national community of values through contact with contemporaries drawn from widely representative institutions.

PREFACE

On March 9, 1977, 84 students from 48 colleges and universities across the nation met at the United States Air Force Academy for the Nineteenth Air Force Academy Assembly. During the Assembly, these delegates participated in round-table sessions to discuss the topic, "Nuclear Energy: Do the Benefits Outweigh the Risks." On the fourth day, a final report containing their findings and conclusions was reviewed and approved. The final report expresses the views of the student delegates and does not represent the views or opinions of senior participants who delivered addresses or served as panelists and moderators.

During the Assembly, the participants heard a keynote address by Representative Mike McCormack. The delegates also attended a panel that discussed the Assembly topic. Participating in the panel were Dr. Henry Kendall, a leading figure in the Union of Concerned Scientists and a faculty member at the Massachusetts Institute of Technology; Dr. Petr Beckmann, Editor of *Access to Energy* and a faculty member at the University of Colorado; and Mr. Frank Graham, Director of Special Projects for the Atomic Industrial Forum. Also in attendance were six senior participants from business, academic and government backgrounds who served as moderators of the round-tables, as well as observers from various professional military schools and academies. The texts of the Assembly addresses as well as the delegates' Final Report are presented in this pamphlet.

The United States Air Force Academy Assembly is cosponsored by the United States Air Force Academy and the American Assembly, Columbia University. Neither institution takes a partisan position on any subject explored during the Assembly. The Assembly is sponsored as a public service to provide a setting and a technique for bringing an outstanding collection of undergraduate students together. It affords them the opportunity of studying and discussing a vital national issue, and then inserts their opinions into the flow of American thought.

The background papers used by the delegates in preparing for the Assembly were provided by the American Assembly and have been published in book form. This volume, *The Nuclear Power Controversy,* is available from the publisher, Prentice-Hall, Inc., Englewood Cliffs, New Jersey 07632.

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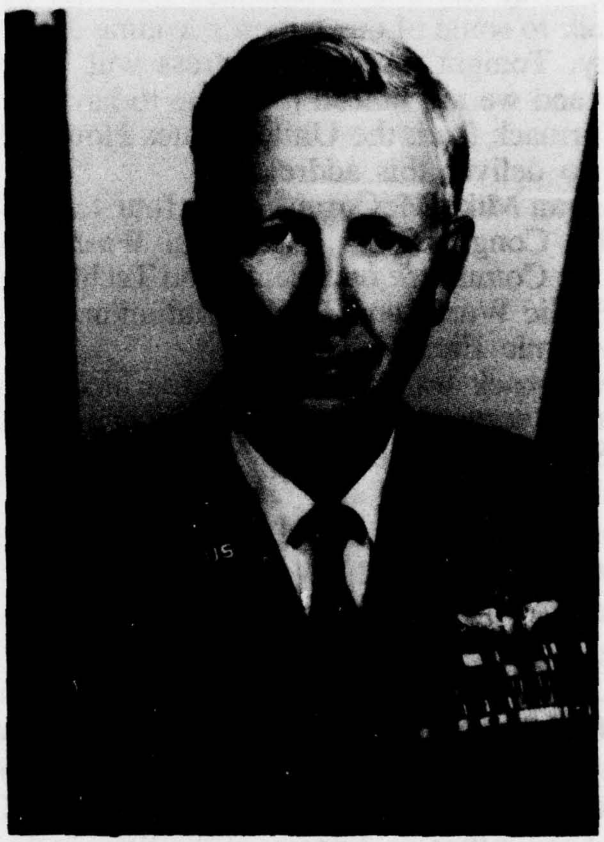
GENERAL WELCOME

REMARKS BY THE SUPERINTENDENT



Lieutenant General James R. Allen

Superintendent

United States Air Force Academy

Lieutenant General James R. Allen

Good evening, ladies and gentlemen. It is my pleasure to welcome the more than 80 student delegates to the United States Air Force Academy and to our 19th Annual Assembly. This year's Assembly promises to be one of the most interesting and provocative events in the Assembly history. I am sure that all of you will benefit from the intensive discussions to be held during the next three days. You will also have the opportunity to listen and talk to some of our nation's leading authorities on nuclear energy. Tonight's keynote address will be the first such opportunity and we are indeed fortunate to have Representative Mike McCormack from the United States House of Representatives here to deliver this address.

Congressman Mike McCormack is a four-term Congressman from the 4th Congressional District in Washington. He is a member of the Committee on Science and Technology, the Committee on Public Works and Transportation and the Joint Committee on Atomic Energy.

Mr. McCormack was born and raised in Ohio and, during World War II, served as a parachute infantry officer. He has BS and MS degrees in Chemistry from Washington State University and was employed as a research scientist at the Atomic Energy Commission's Hanford Project from 1950 until 1970.

Mr. McCormack served fourteen years in the Washington State legislature during which time he authored all of Washington's energy legislation.

In 1971, Mr. McCormack was elected Chairman of the Freshman Democratic Causcus, and also was selected to chair a Task Force on Energy, an unprecedented appointment for a freshman congressman. In 1973, he was appointed Chairman of the New Subcommittee on Energy of the Science and Technology Committee.

Mr. McCormack is an enthusiastic advocate of the Nuclear Fusion Research Program and has obtained substantial increases in funding for it. He recently chaired a special subcommittee to review the Nuclear Breeder Program.

In 1975, Congressman McCormack was designated "Solar-Energy Man of the Year" by the Solar Energy Industries Association. He has lectured extensively on the need for and nature of a systems approach to an integrated national energy policy. Congressman McCormack.

KEYNOTE ADDRESS

March 9, 1977

OPENING REMARKS BY THE HONORABLE MIKE McCORMACK

Mr. McCormack

Thank you, General Allen. Good evening ladies and gentlemen.

I want to congratulate the Air Force Academy for sponsoring this 19th Annual Assembly, and I want to tell you that I am indeed honored to be invited to deliver this keynote address. For many years I have had the privilege of nominating outstanding young men to be appointed to attend the Air Force Academy, and this is the first chance I have had to visit the Academy itself. It has been a great experience for me, even though it has been a brief one, to come here and see the campus — fortunately on this beautiful spring evening — and to meet the cadets from the Fourth Congressional District of the State of Washington.

This seminar is on nuclear energy, and that is fundamentally what I will discuss with you this evening. Several years ago it became obvious to me that one really can't discuss any energy technology in a vacuum — in isolation. Rather, one must consider the entire energy spectrum as an entity. When General Allen introduced me he referred to the fact that I have been talking about a comprehensive, integrated national energy policy. This is really what is important. Therefore, while I will, at your request, discuss nuclear energy, I would like to put it into a perspective about the energy crisis in general.

Understanding the nature of the energy crisis and what our response to it must be is a matter of supreme importance, for it presents a greater danger to our nation than it has faced at any time since the Civil War. Our national security, the credibility of our foreign policies in the eyes of all the nations of the world, the stability of our economic systems, and even the freedom of our political institutions may well depend on our ability to develop responsible energy policies that make sense and have credibility, and to implement rational programs to carry them into effect.

One of the most dangerous aspects of the energy crisis is that a large portion of our fellow citizens still do not understand it. Indeed, recent polls have shown that a majority of the American people still do not believe that an energy crisis even exists, and many who recognize that it is real, believe that it has been contrived by evil forces – scapegoats which they have chosen,

which could, if they wished to do so, simply decide to make the crisis go away.

Another danger is that many of us tend to reject some of the hard facts of the energy crisis because of their ominous implications for our own personal future. We don't want to admit that we can't just take off in our 400 horsepower cars, and drive any place that we want to drive or do anything that we want to do. A surprising number of Americans have been trapped into thinking that the energy crisis has been created as some sort of a game in which each person chooses one form of energy conservation or energy production to support, while opposing the others, such as supporting the Redskins or the Rockets. The truth is that this is a deadly serious matter, and that we need all the energy we can get, from every source, and as soon as possible.

Out of the confused debate that has developed with respect to the energy crisis, perhaps only one concept is universally accepted. That is that we must not waste energy; that we must reduce our national annual energy growth rate. What isn't yet apparent, however, even to many sincere and concerned policy-makers, is that the total energy consumption of our nation must continue to increase for as far as we can see into the future, even if we establish extraordinarily successful spartan conservation programs.

The report of the Ford Foundation Energy Policy Project assumes, as a reasonable scenario for the future, limiting the growth of total energy consumption for this nation to 2 percent per year. This would be a dramatic reduction in our contemporary growth rate of about 3.6 percent, but it may be a long range attainable goal which might not seriously harm the economy.

It is important to understand, however— that a 2 percent growth rate would mean doubling our energy consumption in about 35 years. That's simple mathematics, and you who are familiar with exponential growth rates know that anything that grows at 2 percent per year will double in 35 years. However, since we can't possibly shift instantly to new lifestyles that a 2 percent rate would require for this nation without undergoing serious social disruption, we will almost certainly double our energy consumption within about 25 years. Within this overall growth, there will inevitably be a dramatic shift from the use

of petroleum and natural gas to the production of electricity from coal and nuclear fission. Here the annual growth rate must be about 5 percent or more per year. This will mean doubling electric energy generation by about 1990.

Unfortunately, most of the debate on the energy crisis, in spite of **the perils** we are facing, has centered around such subjects as import tariffs, quotas, gasoline prices, allocation programs, and **regulation.** While all this is important and has been the subject of intense Congressional activity, obsession with it tends to distort our national perspective. I do not take this matter lightly, but acting as if these **problems** constitute the energy crisis is somewhat like wrestling for deck chairs on the Titanic.

The stark realitites are that our domestic oil production has declined about 10 percent since the Arab oil embargo; our natural gas production is down still more; our coal production has increased only 12 percent during this three year period; the percent of petroleum we import has increased from about 35 percent at the time of the Arab oil embargo to about 43 percent today; more railroads have gone out of business; the situation in the Middle East remains unstable; and in Washington, D.C. and among certain elements of the Eastern press, a campaign continues to misrepresent and belittle the potential benefits of nuclear energy, and to exaggerate the problems associated with its development, thus threatening the exploitation of the only source of energy available — along with coal — for energy self-sufficiency, economic stability, and national security during this century.

The challenge we face today is to reject these attempts to confuse us, and to overcome the paralysis that seems to grip us, and to help our fellow citizens understand that we must have a national energy policy with programs to eliminate waste and conserve energy wherever practical, but also to produce the energy that we will need in the future.

If we do create such energy policies and if we implement the programs which will carry them into effect, the people of this country can have adequate energy, environmental protection, and economic stability. If we fail, the inevitable result, I am convinced, will be economic, societal, and political catastrophe, both domestic and international.

There are several fundamentals upon which any energy

policy must be built. Any energy policy must be built upon the best scientific, engineering and economic facts available, no matter how tough and unpleasant such facts may be. We Americans have an unfortunate habit of treating some of our problems as if we are living in a 30 minute TV drama. We have come to expect quick, easy, pleasant solutions, even if it means turning to make-believe.

However, we cannot afford the luxury of basing our energy policies on fantasies, such as assuming that solar energy or geothermal energy with which I am deeply involved, or some suppressed carburetor design, or on some magic which will bail us out of our problems

Nor can we base our policies on anti-public-power or anti-utility-company or anti-Israeli or anti-Arab or anti-oil-company or anti-nuclear prejudices. We cannot base our energy policies on hopes, such as the hope that we will keep finding enough gas or petroleum to keep us going, or the hopes that some of the people of this country can, in blind ignorance, somehow be persuaded to voluntarily accept still higher unemployment, and severly reduce their standard of living in the belief that this would be a worthy goal, just because someone says "this is conservation"

A national energy policy must allow a large segment of our people to continue to aspire to, and strive for, a higher standard of living, with greater freedom and dignity for all. This is American history — the entire affluent society in which we live has been built on a prodigious consumption of energy, and in recent years, on petroleum and natural gas, and, as that runs out beneath us, what we need to figure out is some way to adjust to it. What we can't do is just say, "Well, we're not going to have any more energy." Having a program in this nation to provide an opportunity to strive for a higher standard of living has always been the hallmark of American society. We can't suddenly expect low and middle income Americans or the average American housewife, or the worker in commerce or industry or agriculture, or anyone in any walk of life to sacrifice these aspirations just because we suddenly don't produce enough energy to provide employment for our fellow citizens or because we have planned so poorly that all but the most affluent must cut back on their standard of living.

Certainly each of us recognizes that a sort of three-cornered dynamic equilibrium should exist between energy conversion, transmission, and consumption in one corner, a reasonable and rational program for protecting our physical environment and conserving our resources in the second, and the maintenance of a stable and responsive economic system in the third corner.

So, while we cannot afford the excesses which marked some industrial development of the past, raping our land and polluting the atmosphere, we cannot expect to have energy production without some impact on the environment, no matter how benign the source may seem to be from a distance; and we cetainly cannot expect to have jobs for the American people unless we produce more energy.

So, we have several ''environments'' to protect all at the same time. There are, for instance, those that we classically think of in terms of air, land, and water, but there is also the environment of the job market, and an industrial capacity that will maintain this nation's national security and economic stability. Finally, there is the environment of our homes, and those of millions of low income Americans, where we must have enough energy for a decent standard of living. Our national energy policy must strike this dynamic balance in a rational manner.

Several studies have been completed examining the relationship between energy consumption and employment levels. They indicate that, with much of the waste in energy consumption in industry and residential uses eliminated, and with more efficient production of a million barrels a day equivalent — about 2 percent — could mean the loss of 900,000 jobs. This may be a pessimistic estimate, but it is based on thirty years of accurate data and is the most conservative of the three studies we have seen. This inter-relationship between energy consumption and employment levels makes sense to those who have ever considered it seriously. Now, however, it should sound a warning against our accepting the idea that we can solve our energy problems simply by cutting back on energy consumption.

We obviously can and must eliminate wasteful practices in energy consumption. However, there is a point beyond which further reduction will seriously impact the job market. Obviously, there is no moral justification for policies that would cause increased unemployment because of energy shortages. So,

while energy waste can and must be eliminated, we must never allow one man's concept of conservation to be the cause of another man's unemployment.

High unemployment leads to political and social instability, to Federal deficit spending, and to a further eroding of this nation's relative strength in the international community. All relate *directly to adequate energy production.*

Other nations have learned this lesson, and this is the reason for the heavy emphasis on nuclear energy development throughout the world.

The next fact has to do with our resources of petroleum and natural gas. One of the most important realities that the American people must understand is that this nation has, since *1970, truly passed from one major historical era into another.* We have passed from an era of cheap, abundant fuels, energy, and materials into an era of shortages and high costs which will, at best, be with us for many decades.

That reality is exceedingly difficulty to accept, for us who have lived all our lives in a culture built on cheap mobility and the assumption that American affluence was endless. Nevertheless, we must face the fact that we have, almost certainly, already burned up more than half of all the petroleum, and almost half of all the natural gas we have ever discovered, or ever will discover, on this continent or off its shores, and that it will be gone, insofar as a significant supply of fuel is concerned, by about the end of this century, no matter what price — within reason — we pay for it today. The long range history of Western civilization in terms of energy can be described as a long period before the discovery of coal and petroleum and natural gas, and then one quick blip when it was all used up and then we went on without it. If you think of it just in terms of petroleum and natural gas, it is about one century during which Western man discovered and burned up almost all of the petroleum and natural gas on the planet.

Remember, this depletion of these resources on which we depend so heavily today will be happening while our demand for energy is doubling, even with a successful and spartan conservation program.

I consider it to be especially tragic that the world has plunged into this situation wherein we are burning up our fossil fuels

so wastefully. There is much truth in the observation by the Shah of Iran that petroleum and natural gas are "too valuable to burn." Now we will have an uphill struggle to preserve a portion of them — as we should be doing — as a heritage for the future for feedstocks and for the petro-chemical industry.

As our supplies of petroleum and natural gas dwindle, this nation will become dependent for most of its energy on coal and nuclear fission. However, even these sources of energy are, in the long range perspective, only transitional. Although we must increase our reliance upon them from now until sometime in the 21st Century, we must also make plans for phasing them out in the more distant future, and replacing them with other, still-to-be-developed resources.

In this respect, one general misconception plaguing the Congress as we fund programs for future energy sources is the idea that research and development, lavishly supported, can solve this nation's energy problems in the very near future. Nothing could be further from the truth, as those of you with experience in science and engineering know.

Even with a crash program the time required between the successful laboratory demonstration of a concept for the conversion of an energy source to a usable form and the actual significant implementation of this technology, varies from ten to thirty years, and it's usually closer to thirty. There is no way, for instance, that a tidal wave of Federal funds could make solar or geothermal energy a significant resource for this nation before the year 1990, or nuclear fusion before the year 2000.

So while we must support an aggressive, imaginative, well-funded program for energy research, development, and demonstration in every area of energy conversion, distribution, storage, consumption, and conservation, we must at the same time recognize that the benefits of a research and development program are long range benefits, and that this nation must proceed for the immediate and short range future with the energy sources which are available to us today — coal and nuclear fission.

There is much we can do with respect to our existing energy sources. We must undertake aggressive programs of exploration and drilling for oil and gas, onshore and off. We must explore the potential of an oil shale program, and press for early

application of improved technologies for secondary and tertiary oil recovery. We must convert our wastes to energy or fuels or energy intensive materials.

We must build new refineries, new ports, new pipelines, and new storage facilities for gas, petroleum, and petroleum products. In spite of the fact that we are running out of petroleum and natural gas, this program, along with the most stringent conservation measures, is our only short range strategy for trying to keep our energy supplies for our existing industrial and societal infrastructure as close as possible to future demands.

Of course, coal is our greatest resource of fossil fuel, and we must rely heavily upon it. However, even a superficial glance should warn us against taking it for granted. We will need to dramatically expand our coal production capacity with new mines that meet modern health and safety standards and have a minimum impact on the environment. We must allow coal to be surface mined, with realistic regulations, and responsible reclamation programs.

It will be necessary to restore our railway system with new roadbeds and new rolling stock, and back them up with slurry pipelines.

These tasks— of mining and transporting coal safely — are immensely complex and expensive.

We will, of course come to depend upon synthetic gaseous and liquid fuels from coal, but the cost of these programs in dollar, manpower, steel and other critical materials, in water, in logistics, and environmental protection are literally mind boggling. For example, trying to close the gap between supply and demand for natural gas in 1985 using coal gasification would require more coal than is mined today for all other purposes combined, and would cost literally hundreds of billions of dollars.

In spite of all of these problems in mining, cleaning up, transporting, and burning coal; in spite of the cost of converting it to synthetic fuels, we must proceed with an aggressive program for increased dependence on coal. If we are sincere about attempting to solve the energy crisis that faces this nation, we must think in terms of tripling coal production by the end of this century. Among other things, this will require 200,000 new coal miners.

I am acutely conscious, as I make this point, of the tragic

deaths of 26 men in two separate accidents in a Kentucky coal mine last year and recent deaths in Pennsylvania. To me, it is inexcusable that more has not been done to protect our coal miners from pulmonary diseases and the other hazards they face. Thousands of coal miners have met violent deaths during this century, and we are paying about a billion dollars each year to victims of black lung disease. We must undertake the research to develop safe mining conditions, and we must enforce regulations to insure that these safe conditions are met. The mining and burning of coal must be made as safe as the production of electricty from nuclear fission. This will markedly increase the cost of coal, but this source of energy is vital to our national survival, and it must be made safe.

As responsible citizens sort out the facts with respect to our energy future, it becomes more and more obvious that one of the greatest strokes of good fortune this nation has experienced is to have our nuclear industry as well advanced as we find it toady, ready now to provide much of the energy this nation will need during the next fifty to seventy-five years.

Nuclear energy is the safest, cleanest, cheapest, most realiable source of energy available, with the least environmental impact of any significant option. If we did not have a large block of nuclear energy available to us for the coming decades this country would be in critical danger, even if we succeed in tripling coal production by the year 2000.

Today, there are 65 nuclear plants licensed to operate in the United States. During the first half of 1976, nuclear energy produced about 8.3 percent of this nation's electricity, and it saved the consumer during that six month period about $625 million in rate reduction, as compared to what they would have paid for the same utility for the same electricity if those same utilities had used a fossil fuel plant to produce electricty. Now, we don't have the figures yet for the last four months - November, December, January and February — but I think we are going to find that East of the Mississippi, in the Chicago area for instance, every single coal plant had trouble and was down at one time or another, but the seven nuclear plants all operated full time throughout the period.

Eight more plants are scheduled to be on the line by the end of this year. In addition to these 73 plants on the line, there are

82 more nuclear plants for which construction is underway or authorized. Another 73 are on order or planned. If 200 of these 228 plants are all on the line by 1985, and they *can* be if we simply eliminate unnecessary delays and provide for construction capital; then this nation will have a nuclear capacity of about 200,000 megawatts–about 25 percent of our total national electric generating capacity–by 1985.

Each new nuclear plant saves the equivalent of more than 10 million barrels of oil a year. At $15 a barrel that is $150 million just from that saving alone. It would require more than 5 million barrels of oil a day to produce the same electricity that these 200 plants would generate. This is almost as much as the amount of petroleum that the United States imports today.

With the nuclear breeder program in place in the 1990s, the advantages of nuclear energy will significantly increase, particularly with respect to establishing this nation's energy independence. At the present time we are in the midst of an extensive research, development and demonstration program involving nuclear breeder technologies and are focusing on learning essential engineering facts related to the liquid metal fast breeder. Our demonstration programs will have reached the point by about 1990 that licensing of commercial breeders should be in order. Unfortunately, we are already far behind France, England, Germany, Russia and probably Japan in the commercialization of this technology.

With a breeder program, this nation can convert our large stockpile of Uranium 238, already mined and in purified form, into a nuclear fuel of extraordinary value. This will give our nation a chance at energy independence. The energy that can be produced from the otherwise useless Uranium 238 can, with a breeder program, produce as much electricity as would be produced by more than 5 times all the oil possessed by all of the OPEC nations combined.

Statements that the breeder program presents some sort of special safety problem are simply not true. All nuclear plants produce plutonium. The breeder simply produces more than it uses. This new fuel will, in turn, be used to provide for concurrent energy requirements. Nuclear wastes from breeder plants are not significantly different from the wastes of today's nuclear plants.

I am not unaware of the fact that there are those who have

actually convinced themselves that nuclear energy represents a special hazard to the public, and that the program should be terminated, in spite of its obvious benefits. I appeal to them to recognize the unchallenged fact that the production of electricity from nuclear fission is far safer than most other human activities, including especially the mining, transportation, and burning of coal, which is the only other significant source of energy available.

I appeal to them to recognize that each new nuclear plant will provide energy for 25 to 30,000 permanent jobs in primary industries and in supporting services.

The 200 nuclear plants that can be on the line by 1985 will provide the energy requirements for more than five million permanent jobs for American workers. If this energy is not available, and from this source, these jobs will probably not be available either.

It does no good to provide for national defense if we do not have enough energy to run this country. It does no good to talk about programs to reduce unemployment if we do not produce the energy that the jobs will require. These are the real issues. The anti-nuclear advocates would weaken our country and cause higher unemployment. Their activities have nothing to do with nuclear safety. If successful, they would make this nation even more vulnerable to the oil exporting countries.

Of course, the nuclear industry, just as any other, does have some hazardous aspects, and we must assume that at some time in the future there will be some accident causing property damage, injuries, and even deaths. It is crucial, however, to ask how likely these accidents are, and how this risk compares to that associated with other everyday activities.

While it is essential that every reasonable precaution be taken to guard against every conceivable accident — and this is being done — there is a point beyond which imagining wildly unlikely nuclear accidents becomes meaningless at best. Obsession with such anti-nuclear fantasies, while ignoring the much greater hazards of the real world around us, does a great disservice to the people whom I, as an elected public official am expected to represent, and who also look to you for leadership and a responsible perspective.

A report by Dr. Norman Rasmussen of MIT, published last

year, shows that with 100 plants on the line (as will be the case before 1980) a major accident is 10,000 times less likely to happen in a nuclear power plant than a comparable accident in a non-nuclear facility. Thus, the hazard to any individual or group will be about the same in 1980 — with 100 plants on the line — as the hazard of being struck by a meteor.

To put it another way, the chance that a person will be killed from a nuclear accident in a nuclear power plant in 1980 is one in five billion a year. This means that in twenty years, on the average, and with no further upgrading of these plants, one person in the United States would, on a statistical basis, die as a result of a nuclear accident in some one of those 100 plants.

By way of comparison, we will kill about forty-five thousand Americans a year, and suffer about 2 million serious injuries from automobile accidents. About 12,000 persons are killed by fire or smoke. Overdoses of aspirin and aspirin compounds, cause hundreds of deaths per year. About 1,000 persons die from electrical shock. About 160 are killed by lightning. About 3,000 choke to death on food. More than 2,000 are bitten by rabid animals. About 2,000 are killed in airplane accidents. About 8,000 persons drown each year.

The fact is that not a single person has been harmed by any nuclear accident in any licensed nuclear power plant in the United States, nor has any member of the public been exposed to any radiation in excess of internationally approved standards as the result of the operation of all the 62 nuclear power plants now on the line, and their supporting activities, and the more than 100 US military nuclear reactors now in service.

A word about radiation. If we were to assume 1,000 nuclear power plants on the line, and assuming no advances of emission control technology, the average person in the US would receive the following radiation: 102 millirem per year from natural background, 73 millerim per year from medical X-ray and therapeutic radiation, but only 0.4 millirem per year from the operation of all 1,000 nuclear plants and all their supporting activities. That is less than one-half of a millirem, as compared to almost 200 from natural and medical sources.

New Yorkers may be interested to learn that the radiation leval at the Vanderbilt Street entrance of Grand Central Station, due to the natural radiation from the building's granite, is more than

500 times greater than the radiation exposure a person would receive at the gate of a nuclear power plant from the plant. It is more than 100 times the maximum radiation dose allowed to a member of the public by the Nuclear Regulatory Commission for the closest approach to a nuclear plant.*

The safe storage of radioactive wastes is certainly a requirement accompanying the beneficial use of nuclear fission, and our 30 years experience in the nuclear military program has given us the know-how to do this.

Using techniques that have been developed during recent years, the safe, permanent storage of radioactive materials is actually a simple matter of good engineering and good management.

In hearings last summer before my Subcommittee, the ERDA announced a series of options for the permanent storage of radioactive wastes. The technique almost certain to be chosen involves converting the wastes to a solid glass, similar to Pyrex glassware — and just as inert — and encapsulating these glassified wastes in welded stainless steel cannisters. Ten to twelve cannisters, one foot in diameter and ten feet long, will contain the wastes produced each year by a 1000-megawatt power plant. Each one will represent about $20 million worth of electricity produced. All of this glassified waste from our nuclear energy program through the year 2000 would make a stack about twelve feet deep between the goal lines of a football field. An individual citizen's share of glassified nuclear waste for the balance of this century will be about 4 cubic inches, and most of this material will be non-radioactive glass.

The waste cannisters will be stored in stable geologic formations deep underground. As far as I know, no one has suggested any scenario by which these materials would be introduced into the biosphere.

I am pleased to say that the Congress has taken the initiative in establishing well-organized programs in solar energy, geothermal energy, and nuclear fusion.

The Solar Heating and Cooling Demonstration Act of 1974

*JOURNAL OF ENVIRONMENTAL SCIENCES — July-Aug 1972 - Ragnwald Muller

provides a five-year program to demonstrate the commercial feasibility of using solar energy to heat and air condition residences and other buildings. We plan to have 2,000 demonstration solar heating units on the line by the end of 1977, and, in addition, 2,000 combined heating and cooling demonstration units by the end of 1979.

We have also established a long range, comprehensive program for all aspects of solar energy conversion to electricity, including wind conversion, thermal electric conversion, photovoltaics, ocean thermal gradients, bioconversion and the incineration of wastes for energy, or their conversion to useful fuels.

Solar energy may play an important role in our future, and I am proud of the overall program we have established. We have increased funding for solar energy research and development about one hundred times during the five years I have been involved in the program, to a total of more than $200 million this fiscal year.

However, we must keep the potential for solar energy in perspective. With well-managed, well-funded, aggressive programs, we may, if we are lucky, be able to provide 1 percent of our energy from solar heating and cooling, and another 1 percent from all other methods of solar electric conversion by the year 1990; but almost certainly not before. For instance, if we were to convert 10 percent of our 70 million homes in this country to solar energy for heating and cooling by 1990—and that would be a truly prodigious undertaking—the energy saved would be only slightly more than 1 percent of our national energy demand.

During the recent session of Congress, we encountered success and failure in other areas of energy legislation. The Electric Vehicle Research and Demonstration Act was passed over the President's veto, but the veto was sustained for the Surface Transportation Research and Development Bill. We expect that through an aggressive program of research, development and demonstration, including battery research and extensive field tests, this country may have an electric commuter car within about seven years. We expect it to be competitive with American "second cars"; those used for short, intracity commuting.

During the last week of the session, a bill was tragically lost

which would provide loan guarantees, cost sharing and price supports for demonstration programs involving synthetic fuels from coal, the production of shale oil, the conversion of municipal and other wastes to fuel or energy, geothermal energy development, and solar energy heating and cooling demonstration programs. We will attempt to enact similar legislation this year.

During the last hour of the session, we lost a bill which would create an energy conservation extension service to help provide timely information for the general public on how to conserve energy, and what can and cannot be done. This will be a high priority matter for my Subcommittee, starting in a few days.

We have also established a crash program for geothermal research, development and demonstration. Our goal is to have from six to ten geothermal demonstration plants on the line by 1980. These will be small plants, generating up to fifty megawatts of electricity each, using presently undeveloped types of geothermal energy, such as hot dry rock formations, hot water deposits and geopressured water. Here again, prudence must govern our optimism. Even with such a crash program which we are funding aggressively, it is unlikely that we can produce 1 percent of our total energy from all geothermal sources before 1990.

During the last three years we have experienced very encouraging progress in nuclear fusion research, and certainly we are now operating on a new plateau — one which we have dreamed of and sought for many years. Now, for the first time, we understand the physics and the dynamics of the plasma in which the thermonuclear reaction must take place. This puts us in a position to move forward with a much more aggressive research program; in which we can, with considerable confidence, predict success.

I believe that we can have our first commercially feasible fusion electric demonstration plant on the line by the mid or late 1990s, but this will require engineering studies. If this program,is successful, we may — in the 21st Century — be able to look forward to providing unlimited quantities of clean, cheap energy forever, not only for this country, but for all mankind. We may also look forward to phasing out the burning of fossil fuels and the use of nuclear fission to produce electricity — during the 21st Century.

It should be obvious that we cannot reach these goals of the 21st Century unless we establish intelligent and responsible policies and programs during the balance of the 20th Century. It should be obvious that this is no time for pretending that there are simplistic solutions to the tangle of interlocking and complex problems that face us. It should be obvious that we cannot afford to base our policies on fantasies, fears, hopes, or prejudices. It should be just as obvious, however, that this nation can develop policies and programs which will provide for adequate energy to maintain our economic stability and standard of living, while protecting or even improving our environment and the health and physical well-being of our citizens.

I believe we can do it if we establish energy policies that do make sense and if we implement them at every level right away. Everyone who understands this has a special role to play helping his fellow citizens understand, because the real enemies this nation faces, in the struggle to overcome the energy crisis, are primarily ignorance, fear, prejudice and emotionalism.

We have faced tough problems before. Many of us lived through the Depression and helped fight the Second World War. We never doubted for a single moment what our purpose was or that we would ultimately overcome the difficulties that beset us during those trying times. I am convinced that if the American people exercise the same resilience, confidence, and good sense that we have demonstrated in the past, and if we demand responsible leadership from all of our public officials, and if we demand policies based on scientific, engineering and economic facts, we can overcome the problems that face us today, and help build a better world.

Thank you.

PANEL DISCUSSION

March 11, 1977

Dr. Henry W. Kendall
Professor of Physics
Massachusetts Institute of Technology

Mr. Frank Graham
Director of Special Projects
Atomic Industrial Forum

Dr. Petr Beckmann
Professor of Electrical Engineering
University of Colorado

Colonel Malham M. Wakin
Chairman
19th AFAA, Moderator

COMMENT

The Panel Discussion was scheduled to be held on the evening of 10 March and was to be open to the public and press. Unfortunately, this event had to be postponed as a result of a blizzard which closed the Air Force Academy for almost two days. The full panel was to have included Dr. Theodore B. Taylor of Princeton University; however, he was unable to fly into Colorado Springs as a result of the blizzard and was therefore unable to participate.

The Panel Discussion finally took place at 1530 hours on 11 March in a lecture hall in the Fairchild Academic Building. Because of the severity of the storm, there was no available audio-visual support for the discussion and only the student delegates and senior participants were able to attend the very lively and interesting discussion. The Panelists each delivered short prepared statements of their personal views as to the need for, and safety of, the nuclear energy program in the United States. After their prepared remarks, each was permitted to rebut the statements made by other panelists and the panel closed with student delegates asking questions on several issues that had been discussed by the three panelists.

Although the panel was of an Ad Hoc nature by circumstance, the Assembly delegates and senior participants were fortunate to hear a diversity of opinion from experts of vastly different persuasion and, coming on the heels of the last round-table session, it provided an interesting review of the major concerns discussed within the student round-tables.

ROUND-TABLE AGENDA

Nineteenth Air Force Academy Assembly

NUCLEAR ENERGY: Do The Benefits Outweigh The Risks?

First Session

The Need for Nuclear Power

1. What are the projected energy needs of the United States through the year 2000?

2. What is the projected electrical energy demand for the next twenty-five years?

3. What are the likely costs—economic and other—of failing to satisfy the demand for energy?

4. What is the potential for limiting energy growth through conservation? Can we rely on the "normal" economic response to high energy costs, or changing life-styles, to achieve conservation, or should we use tax incentives, or impose penalties or other legal restrictions?

5. What alternative energy sources are realistically available for the United States in the next twenty-five years—considering resources, status of technology, investment requirements, and environmental effects? To what extent can we look to oil; natural gas; "new" sources (such as solar, fusion, breeders, geothermal); shale oil; coal; nuclear (i.e., the presently developed commercial reactors)?

Second Session

Safety Regulation and Public Acceptance of Nuclear Power

1. How safe is nuclear power? Is it safe enough? What are the hazards in operation, waste storage, etc.? How do nuclear

risks compare with risks of other energy sources—in particular, coal?

2. (a) Is the regulatory structure adequate to the task of ensuring safety? (b) Can the time consumed in the licensing process be reduced without sacrificing safety? (c) What is the role of the hearing on the application for a license? Does the hearing contribute to safety? Does it contribute to public acceptability?

3. To what extent should the federal government share responsibility for safety with the states?

4. What steps can be taken to deal with public concern about safety? Should NRC, or some other agency, attempt to increase the understanding of the public, local officials, state legislators, about technical matters? Are there steps which can be taken to improve confidence in the regulatory process? Are there feasible steps such as siting in remote "nuclear parks," or offshore siting which should be considered–even if not thought to be required for safety?

5. Can the risks of nuclear power be meaningfully compared with those of other energy sources? Is the risk of a catastrophic accident, however remote, qualitatively different from the cumulative risks of smaller accidents—even if the damage from the latter is likely to exceed the former?

6. Who should bear the costs of antisabotage or diversion measures–the government or the industry?

Third Session

International Aspects

1. Are the incentives for other developed countries to "go nuclear" less strong, as strong, or stronger than for the United States?

2. What role can nuclear power play in less developed countries?

3. How adequate are international programs to limit proliferation and to safeguard nuclear materials? Can they be improved?

4. Should the United States attempt to control the export of reactors by other countries? Reprocessing plants? Enrichment plants? Do we have power to control export of technology by others?

5. What measures not now being taken should the United States undertake to minimize proliferation?

Fourth Session

Can the United States' Nuclear Program Be Made More Effective?

1. What (who) is responsible for the present precarious state of the nuclear power program?

2. Who should have primary responsibility for developing and carrying out a nuclear power program—the federal government, the states, or private industry?

3. How should we allocate responsibility for various activities—mining, construction of reactors, enrichment plants, reprocessing plants, etc.?

4. Is private industry properly structured to raise the captial necessary to build the plants (nuclear or coal) required in the future? Can it be?

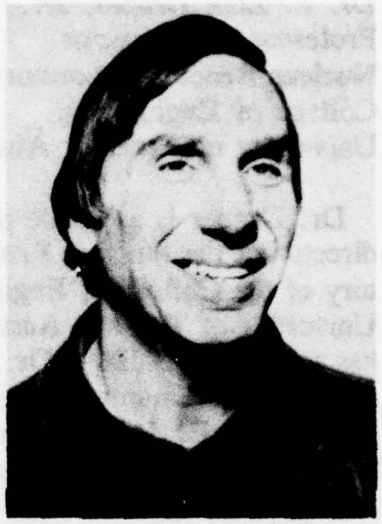
5. Do we need another enrichment plant? Who should build it? When? What timetable should be adopted for breeder reactor development?

6. Should reprocessing plants be built? By whom? When? If reprocessing is deferred, what should be done in the interim? When should plutonium use as reactor fuel be authorized?

7. Waste Storage—how soon should storage method and location be decided? How soon should storage facilities be built? Is present technology adequate?

ROUND TABLE A

Dr. Bernard L. Cohen
Professor of Physics and
Chemical and Petroleum Engineering
University of Pittsburgh



Dr. Bernard L. Cohen is Professor of physics and chemical and petroleum engineering at the University of Pittsburgh as well as the Director of the Scaife Nuclear Laboratories. He holds a BS from the Case Institute of Technology (1944), and MS from the University of Pittsburgh (1948), and a DSc from Carnegie-Mellon University (1950). Prior to coming to the University of Pittsburgh in 1958, Dr. Cohen worked at the Oak Ridge National Laboratory in cyclotron research. He has written about 130 articles for scientific journals and participated in roughly 200 colloquia and seminars. His books include: *Heart of the Atom* (Doubleday, 1967), *Concepts of Nuclear Physics* (McGraw-Hill, 1971), and *Nuclear Science and Society* (Doubleday, 1974).

Delegates

Robert Porter	Adams State
Norm Bobroff	University of Chicago
Mike Acosta	Colorado School of Mines
Charles Loftis	Colorado State University
Brian Cook	University of Houston
Mark Lumsden	UNC-Greensboro
Audeen Walters	Ohio State
Lauren Bauer	Stephens College
Bruce Folsom	Washington
Steven Whitehouse	USAFA
Bart Wohl	USAFA
Jon Barker	USAFA

ROUND TABLE B

Dr. E. Linn Draper, Jr.
Professor and Director
Nuclear Reactor Laboratory
College of Engineering
University of Texas at Austin

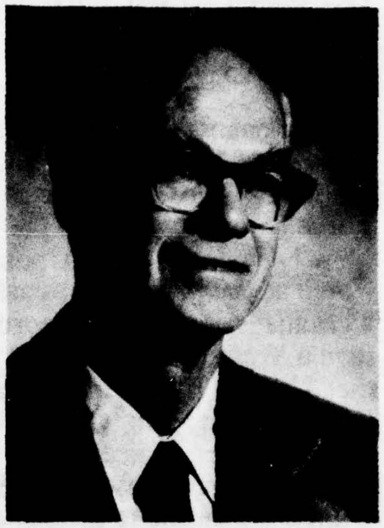
Dr. Draper is associate professor and director of the Nuclear Reactor Laboratory of the College of Engineering, The University of Texas at Austin, where he has taught since 1969. Dr. Draper is a consultant to a number of electric utility companies, E. R. Johnson Associates, Radiation Management Corporation, and the NuTex Corp.

He received his BA in 1964, a BS in chemical engineering in 1965 from Rice University, and a PhD in nuclear science and engineering. from Cornell University in 1970. He is a registered professional nuclear engineer in the state of Texas and is a member of the board of directors of the American Nuclear Society. His fields of specialization are in nuclear and fusion engineering as well as neutron and reactor physics. He is the author of over sixty technical articles and the editor of two books.

Delegates

Mike Lanham	Arizona
Jim Knox	Citadel
Jerry Ocken	UC-Colorado Springs
Lillian Filegar	Colorado Womens College
Mel Kochis	Idaho State
Mark Franz	Montana State
Terry Galganski	Northwestern
Andy Duff	Pittsburgh
Regina Case	Southern Colorado
Jon Alexander	Washington
Bob Wesolowski	USAFA
Charles Milliken	USAFA
Bob Schiermeyer	USAFA

ROUND TABLE C



Dr. Fred H. Schmidt
Professor of Physics
University of Washington

Professor Schmidt received his BS degree in Engineering Physics from the University of Michigan in 1937. After two years with AT&T, he returned to graduate study and obtained an MA degree in Physics from the University of Buffalo in 1940, and a PhD in Physics from the University of California (Berkeley) in 1945. From late 1941 until mid-1945 he worked on the Manhattan Atomic Bomb Project in Berkeley, Oak Ridge, Tennessee, and Los Alamos, NM. He has been a member of the Physics Department faculty of the University of Washington since 1946. He has been the recipient of a Guggenheim Fellowship (1956-57), and of a National Science Fellowship (1963-64). He is a Fellow of the American Physical Society. His research interests have been in those areas and in related scientific journals. His most recent publications include a book co-authored with Professor David Bodansky: *The Energy Controversy: The Fight over Nuclear Power,* (September 1976) and a chapter (co-authored again with David Bodansky) entitled "Safety Aspects of Nuclear Energy," in *The Nuclear Power Controversy,* edited by Arthur Murphy (October 1976).

Delegates

Steve Trevino	UCLA
Jim Johnson	Citadel
Norvelle Brasch	Colorado College
Bill Kammin	Fort Lewis College
Murray Roseberry	Kansas State
Sydna Herren	Miami University (Ohio)
Blake Dawson	Occidental
John Gano	Pomona
Tony Andrade	Texas
Beth Platt	Western State
Rich Lucal	USAFA
Russel Dewey	USAFA
Robert Harrison	USAFA

ROUND TABLE D

Lt Colonel Ernest Park Sims
Deputy Head of Physics
USAF Academy

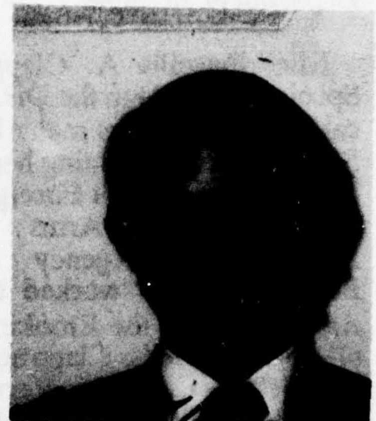
Lieutenant Colonel Ernest Park Sims is a native of New Mexico who received his BS in Chemical Engineering and an Air Force commission from the University of New Mexico in 1958. Upon entering Air Force active duty, he was assigned first as a graduate student in meteorology to MIT, then a Weather Analyst and Forecaster to the USAF European Weather Central near London, England. After a stint as Staff Weather Officer in the United Kingdom Command Post of the Strategic Air Command, he returned to the United States and to graduate school in 1963. In 1965, he completed his MS in Nuclear Engineering at the Air Force Institute of Technology in Dayton, Ohio, and was assigned to the Headquarters of the Air Force Technical Applications Center, Washington, DC, as a Nuclear Research Officer. In 1970, he was selected to be a Military Research Associate to ERDA (then AEC) at the Lawrence Livermore Laboratory of the University of California. There, he spent three years in high-power laser research which was directed primarily toward controlled fusion. Since 1973, Colonel Sims has been a member of the faculty of the Department of Physics, USAF academy, Colorado. He has taught courses in General Physics, Atmospheric Science, and Atomic and Nuclear Physics. He is currently Deputy Head of the Department of Physics and is teaching a dual-discipline, physics and policital science special topics course entitled "Political and Scientific Problems of Nuclear Power and Nuclear Weapons (Proliferation)."

Delegates

Darrell Peterson	BYU
Wayne Fisher	USCGA
Kimball Forest	Colorado College
Kevin Lipson	George Washington
Andy Merril	Lorretto Heights
Steve Harden	USNA
John Hinrichs	Occidental
Amanda North	Princeton
Brian Parsley	Texas A&M
Mark Mathys	UCLA
Mike Eberle	USAFA
Louis Leli	USAFA
Frederick Zeitz	USAFA

ROUND TABLE E

Mr. Alan T. Crane
Professional Engineer
Office of Technology Assessment
US Congress



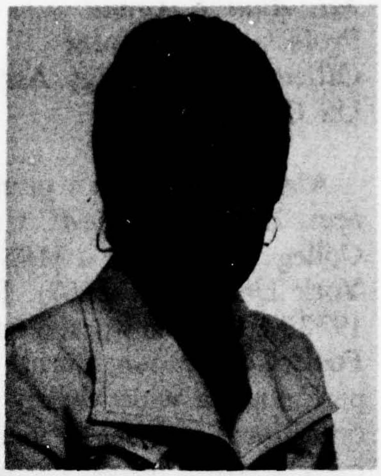
Alan T. Crane is a professional engineer. He holds a BSME from Haverford College (1963) and a MSME from New York University (1968). From 1967 to 1972 Mr. Crane worked for Gulf United Fuels Corporation; during this time he performed a wide variety of safety and operational analyses for nuclear and non-nuclear power plants. From 1972 to 1974 he was supervisor for the performance of thermal-hydraulic safety analyses for nuclear fuels with Bechtel Power Corporation. At present he is with the Office of Technology Assessment of the US Congress; there he has served as the project leader for a study of nuclear proliferation and safeguards, and he has assisted with analyses of the Energy Research Development Administration's Plan and Program.

Delegates

Albert Wells	Cal Tech
Tony Appelhaus	Colorado School of Mines
Robert Toppel	UC-Denver
Carol Kalish	Radcliff Harvard
Bill Haines	US Merchant Marine Academy
Eric Johnson	USNA
Emile Snijders	Ohio State
Van Harlow	Rice
Michele Murray	Tulane
Ken Aamodt	Utah State
Charles Gill	USAFA
Mike Strevell	USAFA
Junior Inglis	USAFA

ROUND TABLE F

Miss Priscilla A. Clapp
Special Assistant to the
Director of Politico-Military Affairs
Department of State



Miss Priscilla A. Clapp is presently Special Assistant to the Director of Political-Military Affairs at the Department of State. Prior to assuming her present position she served as a Foreign Affairs Officer with the Arms Control and Disarmament Agency (1975-1977). Before that she worked as a Research Associate with the Brookings Institution (1970-1975). Miss Clapp holds a BA from Middlebury College in Vermont. She has also studied at the Middlebury College Graduate School of Russian and has attended the University of Oklahoma graduate seminar in Russian. Her publications include: co-author, *Managing an Alliance: The Politics of U.S.-Japanese Relations,* Brookings, 1975; "Okinawa Reversion: Bureaucratic Interaction in Washington," in *Kokusai Seiji,* No. 2, 1974. (Tokyo); co-editor and contributor, *U.S.-Japanese Relations: the 1970s,* Harvard University Press, 1974; contributor, Morton H. Halperin, *Bureaucratic Politics and Foreign Policy,* Brookings, 1974; "The Security dimension of Foregin Aid," in *The United States and the Developing World: Agenda for Action,* Overseas Development Council, 1973; contributor, *The Arms Trade with Third World,* Stockholm International Peace Research Institute, 1971; co-author, *Small Arms Traffic,* M.I.T. Center for International Studies, 1970; contributor, L. P. Bloomfield and A. C. Leiss, Controlling Small Wars: A strategy for the 70s, Knopf, 1969.

Delegates

Rebecca Hartsfield	Cal Tech
Pete Steinmeyer	Colorado School of Mines
Russ Andrews	Colorado State
Diane Mayerfeld	Radcliff-Harvard
David McDaniel	US Merchant Marine Academy
Jim Luebbe	Nebraska
Dave Gomberg	Oregon State
Bruce Montague	St. Mary's
Deborah Hankins	Washington
Ben Schiff	California
Jason Baird	USAFA
John Barry	USAFA
John Buckley	USAFA
Mark Town	Colorado School of Mines

BANQUET SPEAKER

Dr. G. Robert Keepin

G. Robert Keepin was born December 5, 1923, in Oak Park, Illinois. After receiving his Doctorate in Physics in 1949 from Northwestern University, he was appointed a US Atomic Energy Commission Postdoctoral Fellow at the University of California, Berkeley. He has taught at the Massachusetts Institute Technology and the University of New Mexico. He has served as consultant to the Argonne National Laboratory and the Los Alamos Scientific Laboratory and served as a United States delegate to the First Geneva Conference on Peaceful Uses of Atomic Energy in 1955.

From 1963 to 1965, Dr. Keepin was with Headquarters Staff of the International Atomic Energy Agency in Vienna where he headed the Physics Section of the IAEA. His IAEA activities included the organization of a number of international scientific conferences, IAEA technical advisory services, and technical program development in several countries of Europe and Asia. He also served as IAEA Technical Advisor to the Third Geneva Conference in 1964.

Dr. Keepin's many contributions to nuclear and fission physics, as well as reactor kinetics and control are well known throughout the nuclear community. He is a Fellow of the American Physical Society, A Fellow of the American Nuclear Society, and has served on the Executive Committee of various ANS Divisons. In 1973 Dr. Keepin was the recipient of the American Nuclear Society Annual Awards—for Nucléar Materials Safeguards Technology. His continuing interest and activities in US and international nuclear affairs are directed toward the development and implementation of new technology and automated systems for stringent safeguarding and control of nuclear materials on both the national and international level.

Dr. Keepin heads the nation's leading nuclear safeguards research and development effort, being carried out at the Los Alamos Scientific Laboratory where he is the Director of Nuclear Safeguards Programs.

Banquet Speech

I want to thank General Allen, Colonel Wakin, and Colonel Endicott, particularly, for the pleasure of being here and the honor of being the speaker this evening. We have been shopping in Denver many, many times, and I think twelve years ago we visited this beautiful place and the Cadet Chapel. However, I knew little, if anything, about the people and the activities of the Academy, and I am very impressed with the purpose of the Assembly, above and beyond the specific issue of safeguards.

I'm going to tell you a little bit about nuclear safeguards tonight, from my standpoint—from a technical standpoint. I won't be too technical, I hope.

I just want to say, and this is absolutely right off the top of my head, how impressed I am with the spirit that I sense here. I'm impressed, because I've seen longhairs from Harvard, and from many other places, and cadets from the Air Force Academy mix together, and I have sensed a real camaraderie and understanding of all of you with one another. I was also impressed with Chaplain Jim Townsend's prayer. "We have been given much and we are called to give much," or words to that effect. Its sentiment is very true. His emphasis on the global nature of our mutual work and effort is particularly appropriate. What should our effort be? Well, it ought to be the betterment of mankind's condition. We all know that, but it is a very nebulous thing. But to hear those words tonight gives me a perception of the thrust and the mission that I sense here.

I feel very out-going. I've thrown my notes away, and I am just going to talk to you about a viewpoint on safeguards very informally. Perhaps I should have done more to prepare for this presentation; in fact, my wife just reminded me, "this is really quite an auspicious occasion and you should have done more in the way of preparation." Perhaps it's a little better that you just get it straight from the shoulder and off the cuff. Here go the notes. I would like to expound for you a little bit on the topic of pessimism and optimism and relate a little story—a little joke about the pessimist and the optimist.

First, I want to talk about pessimism. We are talking about

nuclear proliferation and the safeguarding of nuclear materials and its political ramifications. About eight years ago—I don't know the date (1969 or something like that)–a cartoon depicting the anatomy of a homemade bomb was printed in a very respected technical journal. It was a real shocker, that this kind of thinking and philosophy would be promulgated in such wide circulating journals. I want to show you a few more cartoons; and these are, to me, the low-level of sensationalist-type journalism approaching a problem of tremendous seriousness to all of us on this planet. In one cartoon we have Buzz Sawyer saying, "Only three atom bombs, Dr. Grover, is all I ask." And Dr. Grover says, "For what nation?: "For my personal use, Sir. I have a great passion for wealth, grandeur, and power." This is my concern: Buzz Sawyer is, after all, representative of the thinking of the average American and the man in the street, etc., and when the subject of nuclear proliferation enters the medium of a cartoon, you know that it has become common knowledge. Sawyer continues, "I would use it to blackmail cities. Think of the billions of dollars that a city with 5 million people would pay to avoid utter destruction." And, of course, Dr. Grover's comment: "You are mad!" It's funny here, tonight; but again, seeing this caused me great pessimism.

These types of things are depressing. They are depressing to me, and I'm sure they are to you. This kind of popularistic approach to things should be beyond any kind of superficial sensationalism, because the security and the safety of the beloved planet that God has given us here is in the balance. These are part of my reasons for being pessimistic. Many people will tell you that there is no real need to worry or fret and work so hard to prevent proliferation and prevent the diversion and theft of nuclear materials and their malevolent use, etc., because it's going to happen. But, in the meantime, doesn't it behoove all of us who have talents to bring to bear, to do all that we can to prevent this from happening?

I want to talk to you tonight about some of the things that we are doing in the technical area, that I hope will not be in too technical a vein, but that are helping to ameliorate and strengthen our defenses against misuse of nuclear materials for malevolent purposes. Because of this work, I'm quite optimistic that we can have effective and stringent safeguards of nuclear materials

against their misuses, and that it can be cost-effective. If safeguards cost an infinite amount, they will not be effective and will not be used. Therefore, even within the nuclear industry, you've got the bifurcation of this pessimism and optimism.

This brings me to my story. There was a father with two young boys about eight and ten. One was a confirmed pessimist and the other was just a hopeless optimist. The father thought, "I'm going to fix those two guys." So, when Christmas came, he took the big guest bedroom and put a partition in the middle of it. He then filled half the bedroom with marvelous toys for a boy about eight to ten years old. Floor to ceiling, the room was full of great toys. The other half he filled from floor to ceiling with horse manure. On Christmas morning he brought the two boys down and said, "Boys, here are your Christmas presents." The pessimist's face, even with all the toys, was as long as it could be and he was totally downcast. The optimist was absolutely overjoyed with his present which, of course, was horse manure from floor to ceiling. The father asked, in turn, "Well son," to the pessimist, "what in the world has got you down?" He said, "Well, Dad, these toys here, you know, many of them I won't like, and the ones I like I'll play with and then they'll break and I'll feel real bad about them being broken, and they'll wear out." Overall, it was a real sad scene.

The optimist said, "Oh, Dad, this is the best present I've ever had in all my life! This is marvelous! Oh, this is fantastic!" The father said, "How in the world, Son, can you say that this is great?" The boy answers, "With all this horse manure, there's got to be a pony in there somewhere."

Now, with all this horse manure, with all of this sensationalism, there are legitimate reasons for attacks on the nuclear community, and there are grounds for legitimate criticism of nuclear power. However, the sensationalist type of thing that just scares the dickens out of Americans—that is the kind of thing that is horse manure.

What is behind all of this? There is the hope and promise of nuclear power. I realize that I am biased. But I do believe that we have got to have nuclear power. You know some of the statistics, I am sure. That a modern nuclear power plant is the equivalent of about ten million barrels of oil imported per year. You know your business here at the Academy, and it is national

security; my business is energy and making energy viable. National security requires energy independence. If you don't believe it, look at the kind of blackmail situations you can get into. Energy independence requires, among other things, nuclear power, coal, conservation, geothermal, wind, and all of these sources of energy—solar, certainly. We cannot afford to miss this very good bet in nuclear power. But we must make it right; we must make it safe; and we must take care of the waste products that result from its use.

At Los Alamos (LASL), we are addressing ourselves to many aspects of nuclear power, especially its safeguarding. As Mason Ruark has said, "Safeguards are particularly troublesome problems in the dyad of the safety safeguards and waste management." This is especially true because safeguards have to do not only with malfunctioning of machines but with the malfunctioning of men. Here, of course, I refer to the whole sordid business of diversion and theft and home-made bombs, and maybe not so home-made bombs.

Permit me to get into a little technical material, and I am sure just about everyone here is going to be able to follow me. I'm going to try and make it so you can. The nuclear materials that are the key constituents of nuclear weapons are mainly two fissile materials—Plutonium 239 and Uranium 235. Both of these are highly fissionable materials. Neither of these materials is found in nature in any useable form. They have to be produced in a plant. For example, Uranium 235 has to be produced by enrichment in an enrichment facility. The current type of technology, of course, is gaseous diffusion. We have plants in Paducah, Kentucky; Oakridge, Tennessee; and at Portsmouth, Ohio. I'm going to show you inside one of those plants in a minute, and the instrumentation that we're using for stringent controls of materials. The point I am making is, however, that uranimum must be enriched in a plant. Plutonium has to be extracted from spent fuel—that is, from the capture of neutrons in Uranium 238 and that also has to be produced in a reprocessing plant. Many of you know this but you'll excuse me for the primer here, because for some of the others, perhaps, this is useful.

Since the material originates in a plant, the first line of defense against diversion or theft of nuclear materials would be stringent controls of the nuclear material in a plant. This, in turn, requires

a capability for the safeguarding of nuclear material in the facility. We have what is called, in Washington, threat credibility analysis. It is serious business. Imagine a threat on a city. I'm not going to talk about this much—you all probably remember one of the threats that was publicized in Orlando, Florida, about three or four years ago. The threat on the city went something like this: "If you don't give me a million dollars, I'm going to blow up Orlando ." These things are not all that infrequent. There has to be an analysis of how credible this is. Does the design that this prepetrator proposes make any sense? It requires great expertise to make that judgment. The terrorist claims to have an amount of material. Is anybody missing any material? This means you need a means for timely and accurate inventory-taking. You have got to know if Oakridge, Argonne, Los Alamos, or Rocky Flats are missing any material. This requires a capability for accurate and rapid inventory-taking, and that is where our technology comes in. I want to spend the rest of the time going into the implementation of a total plant-wide stringent inventory measurement and control system. Our business is the development of instrumentation. We call it on-line, real-time instruments for measuring nuclear materials, and I'm going to explain some examples of that kind of instrumentation at various places.

Before I start, I want to discuss in very simplistic terms the layout of a typical nuclear plant. The Dynamics Materials Control Section of the plant is divided into material balance areas (MBAs). In each MBA there is on-line, real-time nondestructive assay instrumentation. I am going to show you some examples of this later. The plant is divided into many MBAs; as a matter of fact, the MBAs can be divided into sub-MBAs. We call these unit processes. This provides for decisive control on each little portion of the plant. There isn't time to go into how the plant is divided into portions. It is basically divided along the lines of the functional behavior of each portion, depending on where the material is located and the type of material involved. There are measurements in each of these MBAs which feed into a centralized materials accountability control center. Yes, computers are really in this part. There is a real-time computerized inventory at essentially any moment in time for the whole plant. Around each MBA there is electronic neucleonic surveillance,

and it includes things like motion detectors, personnel monitors, and vehicle monitors. This represents a total system of measurements, deployed at particularly key points within the plant, which are called MBAs and then we tie this all together into a computerized system.

Now, I'll show you what some of these instruments look like. The first will be an instrument at Portsmouth, Ohio. At the Goodyear Atomic Gaseous Diffusion Plant in Portsmouth, Ohio, we have a computerized inventory system installed. We have two in the actual load-out station in the product line where the enriched material comes out. It is at this particular plant where the nation's submarine reactor fuel and our weapon materials are made. This is also where light water reactor (three to four percent enrichment) material is produced for BW and PW reactors.

The gamma enrichment meter is an instrument we have designed for measuring U235 content. It then looks at the U234 through an alpha n reaction on flourine in the uranium floride gas. I don't want to get into it too deeply, but what occurs is the discharge of the product, and in this case, its low enrichment, going into a ten-ton cylinder. These cylinders are being ordered by the hundreds for Japan. Japan is buying billions of dollars per year of enrichment supplement work from the United States. That is where we redress the imbalance of payments for all the Toyotas and other Japanese imports. This enrichment meter measures U235 enrichment on a continuous diagnostic basis and the neutron system measures the U234. The point I want to make is that this not only measures the 235 content for accountability for safeguards purposes, but there is a bonus. It actually measures the grade of U234 and U235, and so it becomes a plant diagnostic. What is important is that the plant manager then benefits because it is a quality control process.

My point is this: There are some odious aspects to accountability and inventory-taking. It costs money, and plant managers do not want it unless it is required. However, it *is* required. The thing that puts the sugar coating on the pill is the aspect that the manager can obtain on-line, real-time, in-plant measurement capability. That can give him process and quality control. If this can be done on a continuous basis, he can adjust through-put levels so that out-put is constantly within the range of tolerance

to be acceptable. Prior to this, there was a long procedure of taking samples, doing chemical analysis, etc., which, of course, was time-consuming and costly.

Now I want to give you a little kaleidoscope of instrumentation that is being used in the nuclear industry on a computerized basis.

The Fast-Flux Test Facility (FFTF) at Richland, Washington, is a forerunner of the fast-breeder reactor. That is where 238 tails from the enrichment process in the enrichment plants are burned up. At LASL we have developed a measuring instrument in the Safeguard Instrumentation Development Program called a Californium neutron source that is used for interrogating the FFTF fuel as it goes through. This is a coincidence system for measuring Pu240. In the active Californium system we are measuring the Plutonium 239 or the fissile content, and in the passive neutron coincidence matter we are measuring the Pu240. This gives us an isotopic ratio and, again, is a diagnostic quality control on FFTF fuel.

Let us move from the fast breeder reactor to a reactor that ought to be familiar to you. Is there anybody here who comes from Colorado? The only commercial high-termperature gas-cooled reactor (HTGR) in the world, certainly in the United States, is at Fort St. Vrain, Colorado, and it is at about forty percent power right now. The full power is about 350 megawatts. General Atomic, the manufacturer of the fuel element at Fort St. Vrain, and LASL, are developing an approach to measure the total fuel content in an HTGR fuel element. The total weight of U235 is about three-fourths of a kilogram. It is in a graphite, hexagonal matrix. We measure the fuel rods by the Californium system, similar to the one I just mentioned. However, this is an active neutron interrogation method for measuring the total fissile content in the total fuel element prior to shipment from San Diego, California, to Fort St. Vrain. Therefore, it is both an accountability measurement and a quality control diagnosis.

We use the segmented gamma scan system in Richland, Washington; Oakridge, Tennessee; Savannah River; and at Los Alamos, of course. It has just recently been marketed by Kent Barry Industries and also by Eberline Instruments in Santa Fe. The container of uranium or plutonium in whatever form—

oxide, carbide, salts, ash, or whatever, up to a five-gallon size container—is rotated and translated past a high-resolution detector, and the isotopic analysis and the measurement of fissile material is done and automatically recorded in the memory of a dedicated computer. The information is then fed into the centralized material accountability control center.

I am just touching the surface of the types of instruments and progress we have made in nuclear material handling facilities for real-time measurement. If I might just digress for a moment, think of how it used to be. It was necessary to take a sample for chemistry and, in product material, this was particularly disturbing. For example, statisticians would tell you one out of ten fuel rods have to be tested. In order to get ninety percent quality at some level of assurance, how many do you have to sample out of how many? One out of a hundred? One out of ten? Take the one and cut it up, dissolve it, and do whatever kind of chemistry you have to do to finish the analysis. Now, with *non*-destructive assay instrumentation, you can measure every single one of the fuel elements or every one of the fuel pellets. In other words, there now can be *one-hundred percent* quality control and inventory measurement. This is not on some prorated statistical basis, with the hope that the sample you picked is representative of the whole population. I think you can see the advantage of one-hundred percent sampling.

The well-coincidence counter is used for measuring plutonium, and ash plutonium oxide, and is also now being used in glove boxes both at Rocky Flats and Los Alamos in the plutonium fabrication and recovery facilities. It is used for measuring plutonium scrap and waste in barrels. It is put in an enclosure surrounded by boron triflouride neutron measuring tubes. A whole four-Pi enclosure is used. The counting rate of Plutonium 240 can then be related to the amount of plutonium in the barrel. This replaces a very awkward method of chemistry sampling that was used in the past, and, of course, in barrels of heterogenous materials there is very little confidence that what you get in the way of a sample out of the top of the barrel is representative of what might be in the layers lower in the barrel. With the development of this new instrument, the whole business of representative sampling and its problems are obviated by

having penetrating radiations interrogating what is in the whole volume of the barrel.

In a plutonium plant eveything in the washrooms and the offices, where there should be and is no plutonium, every bit of wastepaper towels, scratch pads, etc.—all have to be checked and monitored before they leave the site. It is possible that plutonium may have gotten into these areas. This is what is called room-generated waste— not line-generated from the actual "hot" plant, but from the administrative and cold support areas. We have an instrument that automatically screens this room-generated waste and scrap to determine whether or not it is above or below the fiducial of ten nanocuries per gram. A nanocurie is ten to the minus ninth curies and it's a very, very infinitesimal amount. However, that is the level at which generative waste and scrap can be buried at a geologically isolated burial site. That level, incidentally, was determined by a panel of experts to be below some of the higher uranium activity areas of the earth. So that level was determined by a comparison with what Mother Nature herself allows in this earth of ours. That is the sort of natural fiducial used for determining whether or not material can be buried in isolated geological formations or whether it must be enclosed in hermetically sealed and recoverable above-ground containers. This instrument automatically determines whether or not it can go below ground in nonretrievable storage, in isolated geological formations.

At Los Alamos we use a portable probing instrument to monitor our uranium fabrication facility. Of course, uranium is not nearly as toxic as plutonium. I'm sure that Bernie Cohen, if he was here, went into this. But uranium, nevertheless, can collect in ducts and traps and pipes, and, if enough gets trapped, it can result in a critical safety problem. So there needs to be a means of monitoring where the material is. This is called in-plant holdup.

We said earlier that plutonium comes from the recovery of the plutonium in spent fuels. For example, in light water-reactor material, the Uranium 238 that is the abundant isotope, under neutron capture eventually results in the production of plutonium. That must be separated out. To measure plutonium in a fuel element which is in its lead cask—let us say a 5,000-pound lead cask—wherein there are some 60,000 curies, we use neutron interrogation for deuterium-tritium reaction. This is

translated past the neutron source and interrogated with that source and the resulting delayed neutrons. The resulting delayed neutrons emitted from the fissile material are "zapped" and monitored in a manner similar to radar. If things are calibrated just right, the spots are directly proportional to the amount of fissile material, and that would be the plutonium that is built in. This provides a means of actually determining the plutonium content in spent fuel without ever even opening up the shielding cask that it is in. This, of course, has great operational safety implications.

The main point I want to get across tonight, and this is very important, is that in any of these kinds of admittedly dangerous materials, one of the things that must be done is to separate the material from homosapiens—man working in the plant—from the would-be diverter, the thief, or the terrorist. If it can be behind impenetrable barriers, such as a leaded-glass hot cell, then so much the better. Radiological protection, more physical security for the material, and criticality safety are enhanced. In order to do this, there must be a remote measurement capability. If persons have to be in there, taking samples, cutting off a little piece, dissolving a certain portion, taking those out of there through the glove box, the rubber gloves—then that is an excuse, a reason for a person to be taking out some of the material. He has a legitimate reason. With remote control, assay and measurement, there is no reason for people to handle the material. This is a great contribution to security and integrity of the total system. What results is called total containment of the material in the plant.

We take our technology at LASL to other facilities. We have a mobile nondestructive assay which has a D-T neutron source that is used for active interrogation. Fifty-five-gallon barrels are put on buckets on the trailer and brought up and actively interrogated. We have onboard passive instruments, some of the type that I have mentioned, allowing us to take the technology to many different locations around the country. Our assay laboratory has been to Rocky Flats and many other places. We are presently using it at B-25, the gaseous diffusion plant at Oakridge.

As I said at the beginning, these materials originate in a plant. They're not found in nature. So, the first line of defense against diversion and theft and misuse of materials would be to have

it controlled at the plant, which is its point of origin. We are developing the Los Alamos Plutonium Facility as an example of a total plant-wide real-time materials control system. There will be a similar installation of this technology at the Rocky Flats plant also. We call this the DYMAC, and it stands for Dynamic Materials Control. It is the integration of all the instruments in each of the Material Balance Areas in the plant with a computerized control system, so that there is central inventory control. A continuous knowledge of what, where, and how much material there is in the plant at all times is available. This system will be ready for operation in August of this year. We expect to get approval from who will then be, I'm sure, Secretary Schlesinger. We already had it from Mr. Seamans, but he has left ERDA (the Energy Research and Development Administration). We now have an industry-wide, and also international showcase of the application of a plant-wide stringent real-time materials control system at the plutonium facility at Los Alamos. Assuming that it is as effective and stringent as we think it will be, and as our calcualtions show it could be, then this kind of technology would have to be transferred throughout the nuclear community, not only in this country, but ultimately throughout the world. We have, for example, this month, some eighteen inspectors coming over for a training program in DYMAC so that the business of training and technology transference goes on.

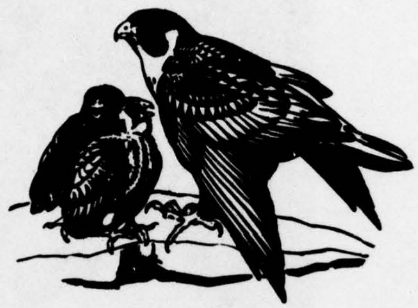
I would be happy to entertain questions. I've just tried to give you a little picture of the salutary inpact that we believe technology can have in implementing stringent and tight safeguards. It's not the whole solution to the problem. I realize this. There are political problems, and ethical, moral, and many other problems. But we feel that technology can have a very great positive impact in implementing good, tight safeguards over nuclear materials.

I think with that I'll close and thank you for your kind attention. I'll be glad to try and answer some questions.

FINAL REPORT

NINETEENTH AIR FORCE ACADEMY ASSEMBLY

March 9 — 13, 1977



At the close of their discussion, the delegates to the Nineteenth Air Force Academy Assembly reviewed as a group the following statements. Although there was general agreement on the Final Report, it should by no means be assumed that every participant subscribes to every statement.

> The opinions, interpretations, and conclusions in the Final Report of the Nineteenth Air Force Academy Assembly are those of a majority of 84 students from 48 colleges and universities who attended. The contents of this report are in no way to be construed directly or indirectly, as indorsed or approved by the US Air Force Academy, the US Air Force, or the Department of Defense.

Modified and Approved by the Assembly Delegates

NINETEENTH AIR FORCE ACADEMY ASSEMBLY

FINAL REPORT EDITOR

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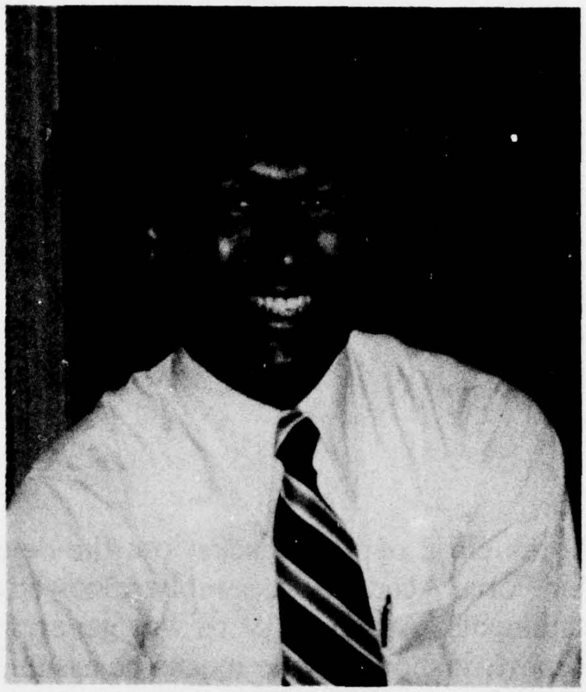

Dr. Dale M. Meade is a research director in Princeton University's Plasma Physics Laboratory. He holds a BS in electrical engineering (1961) and a PhD in physics (1965), both from the University of Wisconsin. Prior to coming to Princeton in 1974, Dr. Meade was a member of the physics department at the University of Wisconsin. Since 1974 he has been project director for poloidal divertor experiment operations at Princeton.

FINAL REPORT

Energy growth rate in the United States depends on the rate of population increase, gross national product, and per capita energy consumption. Maintaining the current standard of living in this country will rquire a steady annual increase in energy consumption. Increasing energy prices and the marked reduction in the growth rate of the US population have raised the possibility of limiting the rate of energy growth through conservation measures and a change in social values. Our goal for US energy growth rate is to achieve between 2 and 3 percent per year by the end of the century; during this period, it should slowly decline from today's rate of 3.6 percent to our goal of 2 to 3 percent.

While the annual growth rate in consumption of energy can be reduced to between 2 and 3 percent, the demand for electrical power is projected to increase at a substantially higher rate. In recent years this rate of increase in electrical demand has been about 7 percent per year. We can expect, as the country switches from fossil fuels to electricity for home heating and transportation, that this growth will remain steady or even increase. If we are to meet future energy demands, the substitution of electricity for fossil fuels must occur. Consequently, by the year 2000, the growth rate of electric power generation will probably be between 7 and 10 percent.

There will be short term and long term effects of failing to meet these projected energy and electrical power demands. Surely an immediate effect will be some form of economic disruption. In the United States, such disruption could take the form of recession, with its associated unemployment, a decrease in productivity, and a lowered standard of living. With the energy intensive nature of food production in this country, an energy shortfall could cause reduced agricultural output and raise the threat of world famine. The American people have historically adjusted to changes and thus, in the long term, the disruptions may not be as significiant as in the short run.

The economic effects may well lead to political repercussions. An energy shortage in the US could hurt our national morale

and balance of payments, increase our hostility toward Third World energy producers, lead to heightened international tension, and a reduction in the international prestige of the US.

While failing to meet energy needs will certainly hurt the US, satisfying these demands has its own drawbacks as well. Some of these might be environmental destruction and loss of our country's aesthetic resources as domestic energy production increases, as well as possible changes in our traditional ideas of individual rights. In addition, there is some question as to whether persistence in traditional social values stressing growth and consumption might not be harmful in the long run to our social and psychological health.

Energy conservation is a major topic in discussions on how to reduce the difference between our projected energy needs and our energy resources. Both free market forces and government action seem to have potential for slowing the rise in energy demand. Increasingly expensive fossil fuels will encourage industry to conserve as it becomes economically desirable to do so. However, the public can be expected to resist some conservation-forced changes in life style even as shortages occur. For example, increased gasoline prices seem to have little effect on reducing consumer demand. Nevertheless, the Assembly recommends that legislation be adopted to extensively encourage public conservation efforts.

Increasing public awareness of energy conservation has value, but it appears that such positive government action, as increased public education programs, must be taken. We recommend waste reducing tax incentives that encourage home insulation and increased electrical efficiency, and increased funding of mass transit. Mandatory conservation measures should be considered, but they should not discriminate against low income consumers.

Conservation cannot satisfy our energy needs alone, we must utilize other resources and emphasize diversification of our energy resources. Oil, though of decreasing importance, has potential if its price is deregulated, thereby encouraging reopening of older, less productive and presently uneconomical oil fields and allowing tertiary recovery of oil from operating oil fields. New reserves may extend the availability of natural gas. Solar, geothermal, tidal and wind power are also alternatives and are particularly environmentally attractive, therefore, we should

encourage development of these sources during the next 25 years even though the actual contribution they can make to our net energy reserves by the year 2000 is undetermined.

The brightest hopes for satisfying electrical energy demands seem to be placed on coal and nuclear fission. Coal has environmental drawbacks to its use, but it is plentiful and readily available. Nuclear fission has many drawbacks as well. The drawbacks of both coal and nuclear fission are likely to be dealt with successfully as energy shortages become more prevalent. Because the energy producing capacity of all other new energy sources is problematic, we can only realistically rely on coal and conventional nuclear fission to fill the gap until first the breeder and then the fusion reactor become alternatives.

In considering the safety of any power plant, it must be realized that no system is completely safe. However, it appears that many aspects of nuclear reactors which the public feel are unsafe are, in fact, relatively safe. Nuclear reactors cannot explode like bombs and their radiation emissions are negligible under normal operating conditions. Although possible core meltdown and high-level radiation waste disposal present a safety hazard, when compared to the dangers associated with our present coal cycle, it appears that nuclear power is safer than the coal option.

It is apparent that comprehensive nuclear regulation is one of the reasons for the nuclear power safety record. It will be important in the future to adopt a more comprehensive and continually updated safety program to ensure this good record. Public hearings on nuclear plants are also very important and should not be eliminated. They provide an essential mechanism for public input as well as providing the insight and awareness so necessary if nuclear power is going to be publicly accepted.

We recommend that by consolidating and organizing nuclear regulation, it may be possible to cut the time consumed in the licensing process. For the sake of uniformity, the federal government should be responsible for setting minimum safety standards. The states, though, should retain the power to regulate nuclear plant siting. Both federal and independent state inspection should be regularly held in order to both force compliance with federal standards and reduce the possibility of personal bias in the inspection system.

One of the most important aspects of public acceptance of nuclear power is education. Although the federal government should be responsible for the dissemination of unbiased information, the NRC is a regulatory agency and should not be involved. Instead, the job of public education on energy sources, such as nuclear energy, should be handled by an agency such as ERDA. This agency would have to adopt an avowed policy of neutrality, a policy which has not always characterized ERDA's pronouncements in the past.

One of the suggestions for increasing nuclear safety has been locating nuclear plants together in "nuclear parks" or, perhaps offshore sites. Although these sites could ease security problems and cut transportation risks of waste materials by locating reprocessing plants near the parks, there are unanswered environmental questions that should be addressed.

One of the problems with nuclear power is the chance of a nuclear catastrophe, either by sabotage or perhaps a core meltdown. Such a catastrophe could cause panic on a national scale. This further points out the need for strict and continually updated safety regulations. As for sabotage, both industry and the federal government will have to work together to insure that proper security measures are implemented.

The problem of steadily increasing energy demand is not unique to the United States. All developed nations face this same dilemma, but whether their solution for it will be nuclear power depends on several factors such as the differential between the country's energy demands and resources, the amount of national wealth that can be committed to achieve energy independence and the availability of cheap energy sources in both political and economic terms—like Mid-East oil.

Because of their high degree of industrialization and lack of indigenous energy supplies, Western Europe and Japan seem to have the strongest incentives for adopting nuclear power. These regions also have the necessary capital to develop nuclear energy, and would undoubtedly feel more secure if they were less dependent on foreign oil. Despite some problems with public and political opposition to nuclear power (such as in

Sweden, for example), Japan and Western Europe seem destined to go to nuclear power much more quickly than the United States.

Nuclear energy is potentially even more important in lesser developed countries. It can provide the energy needed to establish western style industrial growth and economic development. Nuclear power increases a nation's international prestige but also makes possible the development of nuclear weapons. Yet, while nuclear power may seem eminently desirable to a poor nation, it demands the diversion of national wealth from other needs and makes that country even more dependent upon outside technology.

Still, nuclear power is attractive to many countries, and this desirability raises the twin problems of proliferation and control of nuclear weapons. The current non-proliferation treaty is not adequate. Key nations have not signed it, and it has not curtailed the spread of nuclear weapons technology to non-nuclear countries. One goal of existing international organizations should be the strict regulation of sales of nuclear reactors and reprocessing plants. Setting up such an active and effective program will likely prove difficult, but the consequences of runaway proliferation make the effort a necessity.

Independent of international agreement, the United States has a limited capability to control the export of nuclear technology by other countries. In particular, we should do everything reasonably possible to control the spread of reprocessing and enrichment plants, as they are prime sources of weapons-grade fissionable material. Recognizing that our attempts to limit foreign sales may fail, the US should attempt to export its highly controlled and carefully regulated nuclear technology, especially in the areas of fuel enrichment and reprocessing.

The United States can take further independent and multilateral measures to limit nuclear proliferation. It should tie all nuclear sales to strict safety, inspection, and waste-disposal standards. The United States should encourage energy diversification in other countries. This can be done by providing assistance in the development of other energy sources such as solar energy, and utilization of fossil fuel resources as well as providing assistance and incentives for energy conservation. A final possibility would be to create a nuclear energy cartel that would

wield the international power necessary to control the proliferation of reactor technology, especially as it relates to nuclear weapons.

The current status of the nuclear power production program in the United States is the result of historical development, economic factors, and the attitudes of the American people. The record of reactor operation is not flawless; several small-scale accidents have occurred and have served as a warning about the difficulties of nuclear power. Perhaps more influential than the historical record has been the uncertainty of cost estimates related to the nuclear industry. Fluctuating interest rates, price escalations, inflation and legal construction delays have all served to yield inaccurate predictions of the cost of building and maintaining reactors. In addition, much of the initial cost due to research and development which was born by the government is now surfacing, yielding commercial production rates higher than anticipated. Yet, these factors are secondary to the attitudes of the American people. It appears that nuclear reactors create public fear. This may be for a number of reasons, including a general distrust of anything nuclear, a lack of understanding concerning the actual risks involved in nuclear power production, and ignorance of the need for new power sources. At present, a large segment of the American population refuses to believe that there is now, or could be a serious power shortage in the near future.

To overcome the approaching energy shortage, a limited nuclear power production program should be instituted coupled with conservation and a full scale development of alternative energy sources. It should be the responsibility of the federal government to establish the criteria for construction and operation of nuclear plants, while private industry actually implements their construction and operation. Further, government responsibility should include the particular operations of enrichment, reprocessing, and waste disposal management, while private industry should be responsible for mining, reactor design, and the ownership of nuclear plants.

While it is a matter of debate as to whom should finance continued nuclear plant construction, we feel that financing should come from the private sector. This can be accomplished partially with the aid of federally subsidized insurance.

In like manner, needed enrichment facilities should be funded and operated by the federal government; government investment should be recovered through taxation and user fees. In any case, construction of such facilities should be undertaken in the next ten years to avoid rapidly increasing costs.

Continuing controversy surrounds the issue of breeder reactors. Breeders pose technological and safety programs that lead many to believe that their full-scale deployment should be forestalled. In addition, plutonium should be used as a fuel only after environmental testing proves it will not contaminate the biosphere. Research and development continued on this technology with emphasis on additional safeguards, but no decision regarding the commercial development of breeder reactors should be made until the technology has been shown to be adequately safe. Environmental aspects to the possibility of proliferation must also be considered before commercial development proceeds. A major fear concerning nuclear plants is the spread of radioactive waste. Reprocessing and waste storage facilities should be built and operated by the federal government. The construction of waste storage facilities should be undertaken first, and should begin as soon as possible.

NINETEENTH AIR FORCE ACADEMY ASSEMBLY

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The Citadel
Colorado College
Colorado School of Mines
Colorado State University
Colorado Women's College
Fort Lewis State College
George Washington University
Idaho State University
Kansas State University
Loretto Heights College
Merchant Marine Academy
Miami Univeristy of Ohio
Montana State University
Northwestern University
Occidental College
Ohio State University
Oregon State University
Pomona College
Princeton University
Radcliffe College of
Harvard University

Rice University
St Mary's of Texas
Stephens College
Texas A & M
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University of Arizona
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at Los Angeles
University of Chicago
University of Colorado
at Colorado Springs
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University of Miami
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THE ACADEMY ASSEMBLY HISTORY

The United States Air Force Academy co-sponsors its Assembly with the American Assembly of Columbia University. Former President Dwight D. Eisenhower established the American Assembly in 1950, while he was President of Columbia. Both the American Assembly and the Air Force Academy Assembly seek "to provide information, stimulate discussion, and evoke independent conclusions in matters of vital public interest."

From April 1-4, 1959, the First Air Force Academy Assembly was held. Seventy-five delegates from 30 colleges and universities discussed the problem of "International Stability and Progress." Addresses were made to the delegates by Paul H. Nitze, President of the Foreign Service Education Foundation, and Dr. Henry M. Wriston, President of the American Assembly.

Among the conclusions reached by the delegates to the First Assembly were: (1) Military assistance programs to foreign countries are vital instruments of our foreign policy, (2) the cost of these programs is well justified by the savings coming from the gains to our defenses which these programs indirectly bring about, (3) freer trade and long-range wealth-producing economic development of foreign nations are desirable goals, and (4) technical assistance programs overseas should be continued and expanded.

"The Representation of the United States Abroad" was the topic of the Second Assembly, which in March 1960 was attended by 80 delegates from 34 institutions of higher learning. Principal speakers were General Lauris Norstad, USAF (Ret), former Supreme Allied Commander in Europe, and Dr. Harlan Cleveland, Dean of the Maxwell Graduate School of Citizenship and Public Affairs, Syracuse University.

The delegates concluded that: (1) Shortsighted American public opinion is reflected in our failure to develop long term policies and programs supported by adequate and well-planned appropriations, (2) neither programs nor personnel can be expected to improve without definition of national goals and recertification of short-term approaches to the lasting problems of our age, and (3) an increased national effort is necessary to marshal the understanding, appreciation, and support for our

position in the world community.

The Assembly continued to expand, and 104 delegates attended the Thrid Assembly on "National Goals: Challenges for the Sixties." Speakers in 1961 were Currin V. Shields, Professor of Government, University of Arizona; Arthur M. Schlesinger, Jr., Special Assistant to the President of the United States; and Dr. Arthur L. Miller, Pastor, Montview Boulevard Presbyterian Church of Denver.

The Third Assembly offered in conclusion: "We see no need to alter the basic purpose which has given meaning and direction to the life of this country since it was founded. The goals we enunciate are timeless only in the sense that they draw their inspiration from that purpose in the contemporary situation. The goals are also, we would stress, national—we claim for them no universal validity. And yet we hope that the American national purpose if firmly rooted in the values which are universal, and that, therefore, both our national purpose and our goals show a decent respect for the vital interests of other nations.

"Arms Control" was the topic of the Fourth Assembly. Fifty-nine colleges and universities sent 103 students to participate. Key addresses were delivered by Lincoln P. Bloomfield, Director, Arms Control Project, Massachusetts Institute of Technology; Governor Harold E. Stassen, Former Special Assistant to the President on Disarmament; and Ernest W. Lefever, Foreign Policy Analyst, Institute for Defense Analyses.

The topic of the Fifth Assembly was "The Secretary of State" and the Sixth Assembly in 1964, looked at "Outer Space." "The Congress and the American Future" was the topic of the Seventh Assembly which brought together 102 delegates from 63 colleges and universities. The principle speakers were senator Mike Monroney of Oklahoma; Congressman F. Edward Herbert from Louisiana; and Dr. Richard E. Neustadt, Special Consultant to the President. The delegates concluded in part that: (1) Direct election of committee chairmen would promote more efficient operation in Congress than the present seniority rule, (2) members of Congress should be urged to disclose their financial holdings to avoid conflicts of interest, and (3) "although there are dangers involved in the strengthening of the permanent bureaucracy as a result of executive conflict, they are controllable to the extent that Congress is willing to use it intelligently and not

merely for carping its own capabilities for oversight."

The Eighth Assembly studied "Cultural Affairs and Foreign Relations." Concerned mainly with the problem of adequate communication among nations, the Eighth Assembly heard from such people as Dr. Ben M. Cherrington, Director, Rocky Mountain Office of International Education; Senator Thomas J. Dodd of Connecticut; and R. Sargent Shriver, formerly Director of the Peace Corps. This Assembly drew 120 delegates from 67 colleges and universities around the nation. The discussions centered on the following topics: communication with the Communist states and with developing nations; the current emphasis of our cultural activities on the one hand and information and propaganda activities on the other; and government implementation and the work of private organizations. The Eighth Assembly ended on the hopeful note that the future will see increased communication among men and governments.

"A World of Nulcear Powers?" was the problem tackled by the Ninth Assembly which attracted 110 delegates from 64 schools across the country. The Assembly heard from such people as Dr. Donald G. Brennan of Hudson Institute and Dr. Herbert Scoville, Jr., Assistant Director, Science and Technology Bureau, US Arms Control and Disarmament Agency. After discussions on the prospects of nucler proliferation the Assembly concluded: (1) Proliferation is a long process and the prices of proliferation and nonproliferation are unclear, (2) responsible nuclear management is a necessity for the future, and (3) as yet, arms control is a problem for each nation to solve on its own. It is hoped that a search for security will not result in an unstable polycentric world situation.

"The United States and Eastern Europe" was the topic for the Tenth Assembly, its occurrence coming at a time when the events of Eastern Europe were continually before the eyes of the world. Principle speakers were Dr. Raymond E. Lisle of the Department of State, Professor William E. Griffith from the Massachusetts Institute of Technology, and Mr. Leonard Marks, then Director,United States Information Agency. Attending were 106 delegates from 70 collegs and universities throughout the United States. After developing the historical relationship between the United States and Eastern Europe, the delegates then discussed (1) the political and cultural parallels of the individual

countries of Eastern Europe as well as the entire area, (2) the economic relationships of the area, and (3) the question of Germany and Central European security. The Assembly, in its final report called for "independent East European states capable of genuine free choice in their distinctive domestic and foreign policies. . ." and added that "the challenge of East Europe's states is the challenge of reconciling. . .self-interest, national independence, and international stability."

The steadily growing problem of "Overcoming World Hunger" was the topic of the Eleventh Academy Assumbly. Delegates were addressed by Professor Roger Revelle of Harvard University, Professor Philip M. Hauser from the University of Chicago, and Mr. Orville L. Freeman, President of EDP Technology International, Inc. In their final report delegates urged "more multilateral managment of the problems surrounding world hunger" through such international organizations as the United Nations. The Assembly members concluded that "world hunger can perhaps be overcome, but the final answers rest in man's capacity for enlightened instincts."

The Twelfth Air Force Academy Assembly focused its attention on the topic "The States and the Urban Crisis." Delegates had the opportunity to hear and question the views of the Honorable Daniel J. Evans, Governor of Washington, Mr. Donald Rumsfeld, Director, Office of Economic Opportunity, and Dr. Alan K. Campbell, Dean of the Maxwell School of Citizenship and Public Affairs, Syracuse University. In their Final Report the delegates identified the urban crisis as a "real challenge to the American social, economic, and political system. . ." and stated that it should be given "the highest domestic priority." They also cautioned that "there can be no meaningful solutions to any of the nation's urban problems without a new sense of understanding and concern on the part of all Americans."

The topic discussed by the Thirteenth Assembly was "The United States and the Caribbean." Over 100 delegates representing 70 universities and colleges heard from such distinguished speakers as Ambassador Ben S. Stephansky, Director, The W.E. Upjohn Department Consultant, former Ambassador to Ecuador and Venezuela; The Honorable John C. Culver, Congressman from Iowa; William D. Broderick, Director, Office of Caribbean Affairs, Department of State; Paul Cunningham,

NBC News; and Ambassador Jack Hood Vaughn, President, National Urban Coalition, former Ambassador to Panama and Columbia, former Peace Corps Director. At the close of their discussion, the delegates, in their Final Report, stated the view that "the United States must refrain from all attempts whether direct or indirect, to impose any one model for Caribbean development." They also expressed the belief that the "key in the United States—Caribbean relationship is the treatment in the United States of racial and other minority groups." Also the delegates felt that the "United States should pursue a policy of dealing with all governments as they are, without making political or moralistic judgments of other countries' domestic policies."

Delegates to the Fourteenth Academy Assembly addressed the changing nature of Japanese—US relations. The rather dramatic shift in US policy vis-a-vis East Asia coupled with the emergence of Japan as an economic superpower precipitated the need for a fundamental reassessment of the Japanese—US relationship. The delegates discussed the future course of this relationship, the role of Japan in the Asian and world political environment, the possibilities of Japanese rearmament, and Japanese nuclear development. Expert commentary was provided by His Excellency Nobuhiko Ushiba (Ambassador of Japan to the Untied States), The Honorable Marshall Green (Assistant Secretary of State for East Asian and Pacific Affairs), Mr. Hisahico Okazaki (First Secretary of the Japanese Embassy to the US), Mr. Minoru Makihara (Mitsubishi International Corporation), Mr. Richard A. Ericson of the State Department, Professor Gregory Henderson, and Professor Robert Ward, Director of the Center for Japanese Studies at the University of Michigan.

The Fifteenth Academy Assembly focused on the topic "The United States and The United Nation." Delegates discussed the effectiveness of the UN as a legitimate governing body in the international political arena and the United States' role as a chief actor and mediator within the security council. Senior participants included Professor Richard N. Gardner (Director of Freedom House), Michael J. Berlin (New York Post Correspondent to the UN), Ambassador William E. Schaufele Jr. (Senior Advisor to the United States Permanent Representative to the UN), Dr. Edwin Ogbu (Ambassador of Nigeria to the UN), Senator Gale McGee, and F. Bradford Morse the Under Secretary

General for Political and General Assembly Affairs for the UN.

"Choosing the President" was the topic of the Sixteenth Assembly, an issue which has been controversial since the founding of this nation but which became even more important as a result of the Watergate incident. Distinguished speakers included-Professor Emmet John Hughes, Rutgers University; Barry M. Goldwater, Senator from Arizona; Mr. Gary Hart, Candidate for the US Senate; Professor Donald Matthews, University of Michigan; Professor Nelson W. Polsby, University of California; Mr. George Reedy, Marquette University; and Representative Morris K. Udall, Representative from Arizona. In their final report the delegates expressed the opinion that the power of the executive branch had been over-extended on an unprecedented scale, but much of the responsiblity for that increase in power could be traced to failure of other branches of government to fully accept their constitutional duties. There was a consensus that an effort should be made to develop criteria for the qualities a president should have. It was agreed that there should be attempts to increase the number of competitors for the presidential nomination, and the Assembly supported the idea of having a ceiling on expenditures in political campaigns. Finally, the Assembly concluded that emphasis should be placed on revitalization of the educational process as a necessary element in producing citizens who would make the presidency a responsive instrument of the people rather than the aloof office it has become.

The Seventeenth Academy Assembly studied the problem of "Multinational Corporations: Agents of Conflict or Coorperation?" Eighty-six delegates from sixty-three colleges and universites were addressed by such speakers as Professor Richard N. Gardner, Columbia University; Mr. Ralph J. Massey, Johns-Manville Corporation; Mr. Minoru Makihara, Mitsubishi International Corporation; Professor Robert F. Meagher, Fletcher School of Law and Diplomacy; and Mr. Herbert Salzman, Overseas Private Investment Corporation. In the Final Report, the delegates expressed the opinion that "Regulation of MNCs (Multi-National Corporations) is both necessary and desirable," but there were diverse opinions on how best to set up and enforce regulations. The belief was expressed that "MNCs will promote regional/International integration through greater

use of common monetary systems, breakdowns of trade barriers, international market systems and channels for capital flow, and an exchange of socio-political ideas." The Assembly members concluded that "the MNC is an efficient, increasingly important force in the world situation. . .(and they) will continue to have resources and technology desired by the nation-states for their own economic betterment. There is—and will be—a degree of *mutual interdependence*. There seems to be no indication of an "inevitable conflict."

The Eighteenth Academy Assembly dealt with the subject of "Women and the American Economy: A Bicentennial Appraisal." Ninety-two delegates from sixty colleges and universities heard addresses from Ms. Betty Friedan, a pioneer in the American Woman's movement. Ms. Friedan's keynote provided the stimuls for three days of provocative discussion on the present role and impact of women in the economy and what the prospective future roles of women will be. There was also a very lively panel discussion involving Mrs. Catherine East, Deputy Coordinator of the Secretariat for International Women's Year; Dr. Peggy Kruger, Equal Opportunity Officer of the University of Texas; Dr. Jean Lipman-Blumen, Director of the Women's Research Program of the National Institute of Education; and Mrs. Phyllis Schlafly, Chairman, "Stop ERA." The main questions raised by the panel was: What is the need for the Equal Rights Amendment? There was no real agreement either among the panelists or in the ensuing delegate discussion. The Assembly delegates did conclude, however, that the "desire of women for career fulfillment will prompt even greater commitment to the labor market in the future, which, in turn, will heighten job competition because of the increased supply of talent available to the labor market."

Dr. Henry M. Wriston was president of the American Assembly for the first five Academy Assemblies. Dr. Clifford C. Nelson is the current president. Six Superintendents have headed the Assembly here since it started in 1959. They are Major Generals James E. Briggs, William S. Stone, and Robert H. Warren, Lieutenant General Thomas S. Moorman, Lieutenant General A.P. Clark, and Lieutenant General James R. Allen, the present superintendent.

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